REMARKS

This response addresses those issues raised in the Office Action mailed April 5, 2005. Applicants initially would like to thank the Examiner for the careful consideration given to this case. Through the above claim amendments and the following remarks, Applicants have addressed each and every issue raised by the Examiner in the Office Action. Applicants believe that each claim is in condition for final allowance, and prompt notice to such effect is respectfully requested.

Drawing Objection

Initially, the Examiner appears to raise a drawing objection with respect to certain figures which were not specifically identified by the Examiner. The Examiner noted that "the drawings are informal and suitable for examination only" but also indicated that the drawings must be made formal in response to the Office Action. Although these two statements are seemingly at odds, Applicants have prepared and submitted formal drawings at this early stage in the prosecution in order to aid the Examiner's review of the invention. Suitable replacement drawings are attached hereto.

Note that the replacement sheets for Figures 14A-14D are slightly darker than the original drawings. These figures are of a standard type used in the mining industry and are found in most issued patents in this art unit. For example, Fig. 4 of U.S. Patent No. 6,608,913 to Hinton (cited by the Examiner in this prosecution) shows this exact type of drawing, with an identical amount of dark and light space.

Specification Objection

The Examiner next argued that the specification (actually, Claims 14 and 16-20) were objectionable because of certain informalities. In describing the objection, the Examiner posited that Claim 14 is a method claim with "steps drawn to computer data image processes processing" and that Claims 14-20 comprise a mechanical apparatus that is "incorrectly dependent of the method computation modeling processes claim method steps for mapping as found in claim 14." Respectfully, Applicants believe that the Examiner has confused the dependencies set forth in these claims.

Claim 14 is indeed a method claim. As set forth therein, the claimed method is directed to one embodiment of a method for mapping the interior surfaces of a void. The claimed method describes the use of a physical "void mapping robot," and it specifically includes steps of ingressing and egressing the robot as well as using sensors associated with the robot. In addition to these "physical" steps, there are also steps directed to data manipulation to produce a useful and tangible result – *e.g.*, void models and mobility plans. Claim 14 is not merely drawn to "computer data image processes processing."

More importantly, Claims 14-20 do not depend from independent Claim 14. Claim 15 is an independent claim from which Claims 16-20 depend. Claim 14 is a completely separate claim and has no bearing on the scope or interpretation of Claims 15-20. The "robot" Claims 16-20 properly depend from "robot" Claim 15, which includes the physical elements of a "means for moving the robot" and "range data collection means" (among other newly defined physical limitations). See Amendments, *supra*. There is no mixed-mode as suggested by the Examiner, and Applicants believe that the Examiner may have misinterpreted the dependencies.

Moreover, to the extent that the Examiner is suggesting that Claim 15 itself is improper for including both the processing of data as well as physical elements (means for moving the robot), Applicants do not believe this is a proper objection. However, to be clear and to further prosecution on the merits, Applicants have amended Claim 15 above to more particularly point out that this claim is directed to a void mapping robot, and not any specific data processing scheme (producing a tangible result) as set forth in portions of Claim 14.

Prior Art

The Examiner also includes a "prior art" section in the Office Action which discusses U.S. Patent No. 6,608,913 to Hinton ("Hinton") and makes an assumption based on a general purpose dictionary. Neither of these discussions affects the scope of the present claims.

First, the Hinton reference does not teach the claimed elements of the present invention, and the Examiner does not assert a proper rejection that argues such. To be clear, Hinton is far afield from the presently claimed invention. Hinton teaches a method for matching 3D scans using a human guided vehicle for data acquisition. Hinton does not teach about autonomous robot guidance based on collected range data. The present invention autonomously utilizes range scans to plan paths and navigate within subterranean voids. Hinton does not address autonomous vehicle guidance and instead relies on a human operator. Additionally, Hinton does not address access or operations within non-human accessible voids.

Second, the Examiner's re-drafting of the claim term "void" is wholly improper. The Examiner cites a general purpose dictionary (Merriam Webster's Collegiate Dictionary 10th Ed.) to rewrite the meaning of the word "void" – a term of art in robotic mapping of largely open 3-D spaces. The Court of Appeals for the Federal Circuit – the sole arbiter of claim construction – has repeatedly (and

recently) held that a general purpose dictionary can not be used to redefine a technical term and that a patentee is free to be his own lexicographer in drafting patent applications. Phillips v. AWH Corp., __ F.3d ___, 2005 WL 1620331 (Fed. Cir. 2005). Here, Applicants have specifically defined their use of the term "void" in the patent specification. *See* specification at [3], *et seq*.. This definition clearly includes both "subterranean voids" (as suggested by the Examiner) as well as "stand-alone discrete structures such as tanks and bunkers, man-made subterranean structures such as pipes (e.g., sewer pipes) and tunnels, and natural or dug structures such as caves and mines." *See* [3]. This is the common and ordinary definition ascribed to the term "void" by those that are skilled in the relevant art (as well as being the ordinary meaning of the word itself). Therefore, unless expressly limited to "subterranean voids" by a specific claim, the general term "voids" is not so limited.

§ 102 Rejection

The Examiner rejected Claims 1-20 under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,349,249 to Cunningham ("Cunningham"). The Examiner then attempted to read the language of the claims on the Cunningham disclosure. However, it is clear from a review of Cunningham that the Examiner is crediting Cunningham with many concepts that are nowhere to be found within its disclosure. A discussion of the present invention as it pertains to (and distinguishes from) Cunningham will help reinforce the differences.

The mapping of voids using robotic means is not a brand new area of scientific endeavor; however, great advances have been made over the years in the level of autonomy or self-reliance that such robots entail. The present invention expands the envelope of autonomous mapping, and is a quantum leap over traditional methods such as those detailed in Cunningham. Because concepts such as autonomy and self-reliance are used in different ways by different practitioners

in these arts, a discussion of these concepts as used in the present application is set forth below.

The Examiner begins his discussion of Cunningham by assuming that it is a "void mapping robot *autonomous* vehicle 12." Office Action at 5. In fact, Cunningham does not include anything even approaching the claimed autonomy of the present invention. The robot in Cunningham is specifically limited to a high degree of human interaction. A human directs the movement of the robot. *See* col. 4, lines 24-34. The robot is limited to teleoperated systems. *See* col. 4, lines 26-29. Moreover, the movement of the Cunningham robot is tied to a specific initial landmark which must be detected in order to painstakingly orient the robot. *See* col. 5, lines 9-52. Thereafter, movement must be accomplished (with human interaction) in short bursts followed by continued waits in order to re-orient the robot to the rotation of the earth to find an appropriate northing point. *See* col. 7, lines 8-31. Although the Cunningham robot has sensors that can collect certain one or two dimensional data, the present *claims* include a much greater degree of autonomy.

For example, Claim 1 (as amended) is specifically directed to an "autonomous void mapping robot." As used herein, the term "autonomous" denotes the ability to move the robot and adjust a route without human interaction. There is no communication link necessary between the robot and a human outside of the void. This concept is incorporated in the original language of the steps that define the method of Claim 1 as follows:

> capturing local range data...
>
> incorporating said captured local range data into a full data map...of the void
>
> *moving said void mapping robot to a second local position within the subterranean void, the route to said second position calculated*

> *by the autonomous void mapping robot based on an analysis of the full map data including the captured range data...*

See Claim 1 (as amended). The claim amendments clarify what was in the original claims – that the autonomous void mapping robot has the ability, without human interaction, to gather sensed data about the void, incorporate that gathered data into its full data map, and to plan or adjust an existing plan to navigate the robot through the void based on the sensed data. In other words, the operation of the autonomous void mapping robot may be initiated and nothing further need be done until the robot completes its mapping task.

Nothing in Cunningham, or any other prior art asserted by the Examiner or known to Applicants performs these tasks. As stated above, the Cunningham robot is navigated by a human (using wired or wireless teleoperation) to an initial landmark at which it orients itself to the rotation of the Earth. *See* col. 7, lines 8-31. Thereafter, a human navigates the robot as it travels and periodically collects certain data about the walls of a subterranean void. This acquired data is not incorporated into a full data map. Moreover, this data is certainly not utilized by the robot with the full map data to determine (or adjust) the navigation of the robot. Cunningham does not perform any decision-making or route planning at all, let alone based upon acquired data. Clearly, the independent claims of the present invention distinguish over Cunningham.

Dependent Claims

There are many other claimed differences between Cunningham and the present invention that were apparently misinterpreted by the Examiner. Although unnecessary to further distinguish the present invention (because the independent claims are allowable), Applicants wish to respond to certain of the Examiner's suppositions in order to make sure that the record is clear.

With respect to Claim 2, the Examiner states without support that Cunningham "necessarily" is stowed and deployed. This is simply not true. The Cunningham robot can only be placed in easily accessible voids, and there is absolutely no discussion in Cunningham about making that robot partially collapsible, deflatable or otherwise "stowable" in order to utilize the robot in voids (such as pipes) that are not accessible by humans or large robots. In distinction, the present invention provides myriad examples of collapsible (e.g., Figs. 9 and 16) and inflatable (e.g., Fig. 16) autonomous robots so that the robot can be inserted into a bore hole or other small opening and access extremely small voids. Cunningham does not teach or suggest any of these claimed attributes.

Similarly, the Examiner states, with respect to Claim 3, that the Cunningham wheels could be inflated and with respect to Claim 4 that a moveable sensor is the same as folding/unfolding portions of the robot for the purposes of stowing/deployment. First off, Cunningham does not even teach that the mobility means 14 is even an air-filled tire. The Examiner argues this feature without any support within Cunningham. Moreover, inflating and deflating tires as part of a stowing process (as described in the present invention) is very different than merely having an air-filled tire. The Examiner's argument with respect to partially folding the robot for stowing is similarly flawed. No such folding/unfolding or deflation/inflation is discussed anywhere within Cunningham or any other prior art reference cited by the Examiner.

With respect to Claim 5, the Examiner argues, again without support, that Cunningham discloses "the void mapping robot 12 included the robot platform 10, which is docked on the autonomous robot vehicle 12." However, Cunningham does not anywhere in its disclosure teach or suggest a small mobile mapping robot which can be docked to (or undocked from) a docking station that is part of the void mapping robot. Clearly, such functionality is useful when certain parts of the void require an even smaller mapping robot to fit a tight space. Cunningham has no

disclosure of any sort of docking or undocking – it merely has parts that are connected together. The Examiner's assertions to the contrary appear to be groundless.

The Examiner's rejection of Claim 6 is improper because it does not even address the claim language. The rejection is directed to "2-D" video capture (which is not even part of the map data gathering process of Cunningham), while the claim is directed to a 3-D overall map of the void. Clearly, Cunningham deals only with two dimensional maps ("TOPES") and there is no support for any rejection of this claim in light of Cunningham.

With respect to Claim 7, clearly Cunningham does not discuss gathering additional scans that are used to confirm positioning. No such secondary scans are disclosed in Cunningham as it explicitly states that it confirms positioning while at rest – not while moving as claimed herein. *See* col. 7, lines 8-31. Cunningham specifically teaches away form this aspect of the present invention.

The rejections of Claims 9 and 10 purport to show Cunningham's disclosure of a bore hole. In actuality, the cited portion of Cunningham is a bolt that has been pre-placed within the void to orient the robot so that it can gather data and travel by human teleoperation. In essence, because the bolt must be placed within the void, this is the opposite of a bore hole which allows an autonomous robot to enter a void that cannot be entered by humans.

The rejections of Claims 16 and 18 purport to show Cunningham's applicability to operate in submerged environments via swamp buggy tires. In actuality, Cunningham in no way address operations within submerged voids. The concept of a submersible robot equipped with a propeller and/or fins as well as using

sonar to map and autonomously operate within a water filled subterranean void is nowhere presented in Cunningham.

__New Claims__

New Claim 21 is presented to more particularly point out one main distinction between the present invention and the prior art – namely, the ability to autonomously generate a map of the void and to plan and implement a route based on the autonomously generated map. This concept, which is embodied in Claim 1 in a broader fashion, is not taught or suggested by any cited prior art and is fully supported throughout the specification of the present application.

In view of the claim amendments and the above remarks, it is believed that the present application is in condition for final allowance and notice to such effect is respectfully requested. If the Examiner believes that additional issues need to be resolved before this application can be passed to issue, the undersigned invites the Examiner to contact him at the telephone number provided below.

Respectfully submitted,

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